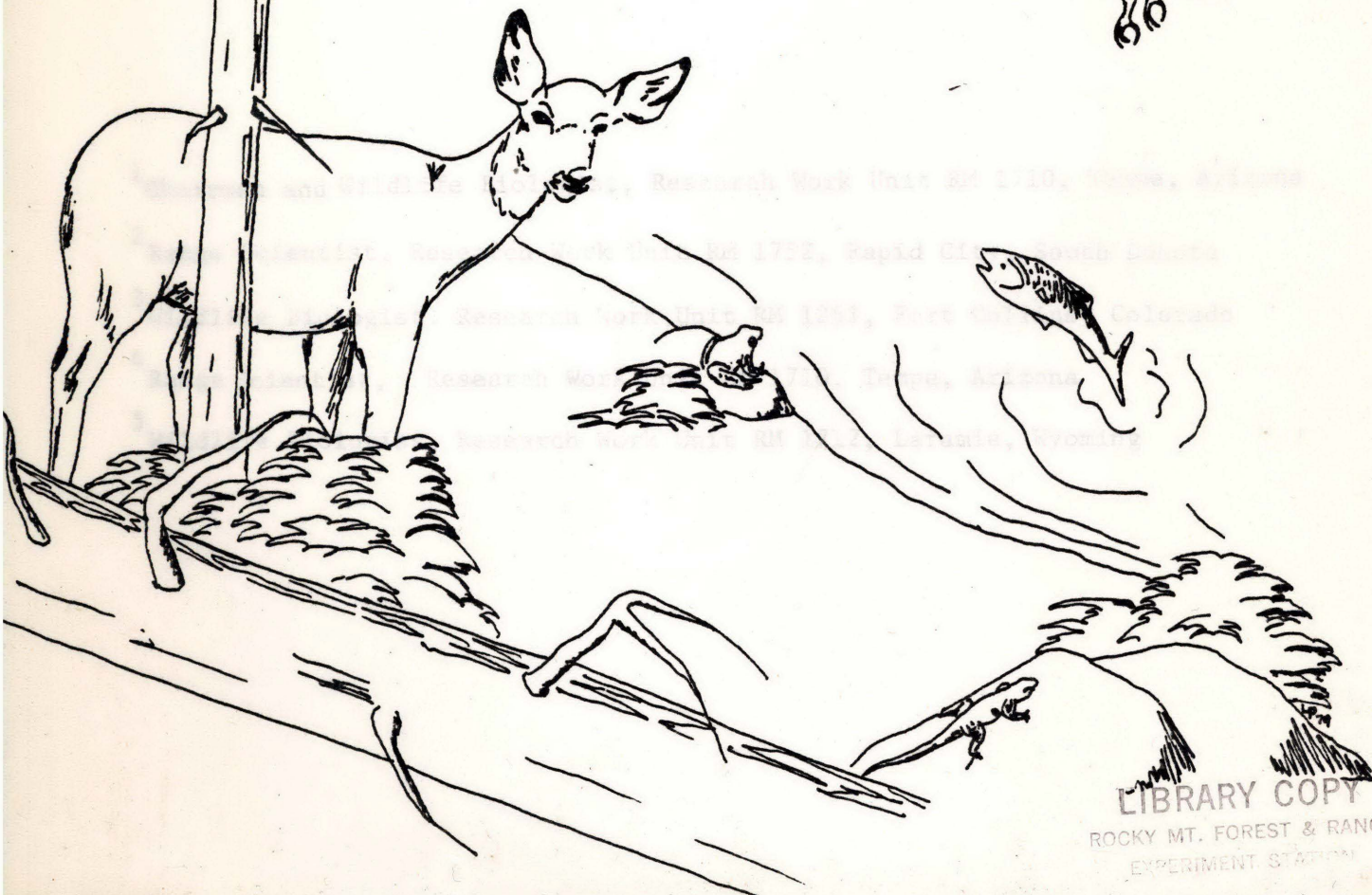


STATUS OF THE RANGE, WILDLIFE AND FISHERIES
RESEARCH PROGRAM IN THE ROCKY MOUNTAIN
FOREST AND RANGE EXPERIMENT STATION

A REPORT TO THE DIRECTOR
AND
COMMITTEE OF SCIENTISTS
MARCH 1979



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EXPERIMENT STATION

Results of a Workshop Sponsored by the Committee of Scientists

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Range, Wildlife and Fisheries Workshop

LIST OF PARTICIPANTS

<u>NAME</u>	<u>WORK UNIT</u>	<u>GROUP ASSIGNMENT</u>
Glen Crouch	RM 1251	Workshop Committee
Leonard DeBano	RM 1606	Visiting
Duane Knipe	RM 1606	Leader-Group 1
Earl Aldon	RM 1651	Group 1
Charles Pase	RM 1651	Group 2
Ross Carder	RM 1654	Visiting
Terry Grubb	RM 1710	Group 2
Clark Martin	RM 1710	Workshop Committee
David Patton	RM 1710	Workshop Committee
John Rinne	RM 1710	Group 1
Kieth Severson	RM 1710	Leader-Group 2
Bob Szaro	RM 1710	Group 1
Lorin Ward	RM 1712	Workshop Committee
Fred Stormer	RM 1713	Group 1
Meredith Morris	RM 1751	Group 2
Ardell Bjugstad	RM 1752	Workshop Committee
Clifford Hawkes	RM 1752	Group 1
Dan Noble	RM 1752	Group 2
Dan Uresk	RM 1752	Group 2
Richard Driscoll	RM 4151	Group 2
Dick Francis	RM 4151	Group 1
Tom Hoekstra	RM 4151	Group 1
Sidney Hanks	Region 2	Workshop Committee
Wally Gallaher	Region 2	Workshop Committee
Bill Fallis	Region 3	Workshop Committee
Bill Zeedyk	Region 3	Workshop Committee
Dixie Smith	RM Station	Visiting
Sam Krammes	RM Station	Visiting

Groups 1 and 2 will meet in a motel room
 Workshop Committee will meet in workshop room

Summary

The Rocky Mountain Station held its first range, wildlife and fisheries workshop in Tempe, Arizona, December 5-7, 1979, under sponsorship of the Committee of Scientists. This workshop had two purposes: to bring scientists together to discuss their research and common problems and to provide the Director with information to reply to a policy letter from the Chief.

The workshop in Tempe presented both an opportunity and a challenge to range, wildlife and fisheries scientists. An opportunity existed to suggest changes in the Station's program to work on problems of regional and national importance and there is a real challenge to be creative in developing new approaches to old problems in short-time periods and probably with less financing.

Although the opportunity for change is present, our analysis of the current range, wildlife and fisheries program is that, within the constraints of available personnel and financing, the Station is maintaining an effort that meets many of the needs of the National Forest System and other federal agencies at both the National and Regional level. This conclusion is based on the number of manuscripts published from completed and current studies in the categories listed by the Regions. There are, however, areas where emphasis should be increased when funds are available or can be reprogrammed. The 10 problems outlined in Appendix E, page 28 should form the basis of future Work Unit Descriptions for the Rocky Mountain Station.

The challenge to be creative is innate in most research scientists. This creativity, however, may never reach its potential because of the lack of a good working environment which includes everything from poor

secretarial services and inadequate office space to autocratic supervisors. Specific recommendations for improving the working environment of scientists were discussed at the workshop and were forwarded to the Committee of Scientists. The Committee's review and recommended action will be sent to Fort Collins in a separate report to the Director.

All of the scientists attending the workshop appreciated the opportunity to review each other's studies and to discuss common problems. Meetings of this type promote professionalism and increase coordination of research between Work Units and should be continued under the sponsorship of the Committee of Scientists. The range, wildlife and fisheries scientists encourage the Director and Staff to be receptive to their needs for creating and maintaining a working environment that leads to productive research for the Station and personal satisfaction for the scientist.

Introduction

In March 1978 Dr. Rupert M. Cutler in an address to the North American Wildlife and Natural Resource Conference made several commitments regarding the U.S. Department of Agriculture's activities to insure that wildlife achieves adequate attention in Forest Service Programs. As a followup to Dr. Cutler's remarks the Chief issued a policy statement in May 1978 that directed the Forest Service to the following goals and objectives:

1. Wildlife will be emphasized in specific program direction.
2. Wildlife representation will be required on multidisciplinary teams that address issues affecting wildlife or fish.
3. We will adopt holistic management as the most acceptable wildlife philosophy and develop national standards that will insure its use.
4. Wildlife and fish goals and objectives will be spelled out in land management plans. Establish controls to insure on-the-ground compliance.
5. Review cooperative relations with State wildlife and fish agencies. Problems that surface should be addressed by putting together an action plan that attempts to reach accord.
6. Work with State wildlife agencies to insure all planning endeavors involving land and/or wildlife and fish species are coordinated.
7. Establish a goal for endangered and threatened plant and animal species that will call for their removal, where possible, from such status by improving, protecting, and managing their habitats.

8. We will establish a research program to fill in knowledge gaps of wildlife and fish habitat needs. To the extent possible, approach this on an ecosystem basis so that interactions between species and interactions between Forest activities and species can be determined.
9. By 1985, devise and adopt:
 - a. A uniform hierarchical habitat classification and assessment system.
 - b. A storage and retrieval system for wildlife and fish and their respective habitat associations.

An accomplishment report on the progress in carrying out the above policy is required from Regional Foresters, Station Directors, Area Directors, and W. O. Staff Directors by March 1, 1979. To assist the Director in preparing his response to the Chief's letter the Committee of Scientists sponsored a workshop (Appendix A, page 18) to review the Station's range, wildlife and fisheries research program.

The workshop was held at the Holiday Inn in Tempe, Arizona on December 5-7, 1978, and was attended by 22 Station scientists and 3 representatives from National Forest System (Region 2 and 3). The format of the workshop was to have National Forest System representatives, Sidney Hanks and Bill Zeedyk, present research needs for their respective region. These research needs were determined by range, wildlife and fisheries people at the forest level and then consolidated in the Regional Offices for presentation at the workshop.

Following the NFS presentation, Project Leaders or their representatives presented a synopsis of their Research Work Unit mission and then outlined

the range, wildlife and fisheries problems identified in their problem analysis. Most scientists in the project working on range, fishery and wildlife problems highlighted their studies in 20-minute presentations.

Workshop Results

The Rocky Mountain Station currently has 19 employees (Appendix B, page 20) including Project Leaders in 8 work units (Appendix C, page 21) that are classified as range, wildlife and fisheries scientists. There are several people in other work units working on range, wildlife and fisheries problems (Ffolliott RM 1654, Noble RM 1752) that are not included in the 19 scientists. Station scientists are actively conducting or supervising 95 studies (Appendix D, page 22) including those financed by Cooperative Aid and Contract. From the research needs presented by Regions 2 and 3, 10 problem areas have been identified (Appendix E, page 28). Region 1 did not have a representative at the workshop but their concerns were presented at the National Workshop in Fort Collins in November 1978. We believe their needs are adequately represented in the problems outlined by Regions 2 and 3. These problem areas are generalizations and do not reflect a specific priority. Additional discussions with each region would be necessary before deciding on problems for inclusion in any work unit revision.

For the three-year period 1976 to 1978 Station scientists and cooperators have published 134 manuscripts (Appendix F, page 30) in professional journals, station publications, symposiums, workshops and conference proceedings. These manuscripts when grouped by subject show that past research efforts have covered 17 subjects and include basic as well as applied research (Table 1).

Table 1.--Number of manuscripts by category for calendar year 1976-78.

Category	Number of manuscripts
1. Reclaiming land	14
2. Techniques	16
3. Land productivity	8
4. Seeding, planting, burning	5
5. Managing vegetation for wildlife	10
6. Effects of land treatments and grazing on wildlife	12
7. Threatened and endangered species	7
8. Vegetation classification and plant taxonomy	10
9. Aquatic habitat	7
10. Plant autecology	12
11. Data storage and retrieval	2
12. Wildlife use of habitat	2
13. Wildlife life history (other than T & E)	17
14. Management systems	5
15. Check lists and general programs	2
16. Research programs and needs	1
17. Unclassified	4
Total	134

The number of manuscripts published from 1976-78 that related to the problems identified by Regions 2 and 3 is shown in Table 2. Over half (57 percent) apply to current research needs. Many of the remaining manuscripts are indirectly related or contain data that could be identified with one of the 10 problems. Most of the published research results have been on habitat improvement and life requirements (Regional Problems 3 and 6). Of the 25 on life requirements, 10 were on deer and elk. Ten of the 37 on habitat improvement were on deer and elk. These figures should not be considered exact because of the difficulty of categorizing a particular manuscript, however, the figures do represent a strong emphasis on a subject.

On-going research that relates to regional needs is presented in Table 2. As with manuscripts the greatest emphasis is on Problems 3 and 6. Of the total (134) publications for the three-year period (76-78) 60 percent (81) have provided information that directly relates to current problems identified by the two regions. When on-going research is compared with regional research needs Problems 1, 4, 8, 9 and 10 indicate areas where we need to do a better job. Problem 1 is concerned with riparian vegetation and is a high priority item by both regions. The Station's effort to develop a Western Riparian Research Program will take care of the need if funding is made available for research in the 1980-1985 period. At the present time, the Rocky Mountain Station does not have research on threatened and endangered plants (Problem 4). A modest start on this problem could be made by funding, through Cooperative Aid, a literature review and case history report on threatened and endangered plants in Regions 1, 2 and 3. This effort could be undertaken by the Herbarium through Feddema.

Table 2.--Number of manuscripts published for calendar years 1976-78 and current studies that relate to the research needs of Regions 1, 2 and 3.

Workshop problem no.	Short title ¹	Number	
		Manuscripts	Studies
1	Riparian	3	3
2	Aquatic	5	11
3	Life requirements	25	28
4	Threatened & Endangered plants	0	0
5	NF Management Act	4	8
6	Habitat improvement	37	24
7	Coordination techniques for range & wildl.	0	7
8	Carrying capacity	2	0
9	Importance of specific vegetation types	1	0
10	Importance of specific habitat components	0	0
		77	81

¹ See Appendix E for problem listing

Problem 7 "coordination techniques for range and wildlife habitat management" involves both biological and economic problems. Coordinated multidisciplinary research suitable for solving such problems may be feasible in some of the new research contemplated at Ft. Bayard, New Mexico, and on the Santa Rita Experimental Range in the proposed arid lands research program.

There is no on-going research that relates to Problem 8, carrying capacity. Other people (Betty Willard's talk at the Project Leader's meeting) have indicated that animal (including man) carrying capacity for all vegetation types for all uses should be a high priority for Forest Service research. While Table 3 does not indicate present research on Problems 9 and 10, some of the objectives in other studies do relate to these problems.

The information used in Tables 1 and 2 comes from published manuscripts and on-going studies. Completed studies without published results were not accounted for in this analysis. There are some data to be published in calendar year 1979-80 that will add accomplishments to the tables.

Two items in the Chief's policy memo of May 1978 related directly to research. These are:

1. "We will establish a research program to fill in knowledge gaps of wildlife and fish habitat needs. To the extent possible, approach this on an ecosystem basis so that interactions between species and interactions between Forest Service activities and species can be determined."

2. "By 1985, devise and adapt:
 - a. A uniform hierarchical habitat classification and assessment system.
 - b. A storage and retrieval system for wildlife and fish and their respective habitat associations."

All of the problems identified by Regions 1, 2 and 3 (Table 2, Appendix E) in the broad sense can be related to these two items. Current research efforts however do not emphasize the ecosystem approach but the Station's studies do focus on certain factors or parts of the ecosystem.

Whether we have research on a particular ecosystem such as a ponderosa pine forest with all its related plant and animal species, or whether we study one species that occurs in more than one ecosystem is dictated by the need for detail required by National Forest System to meet their management goals and legal requirements of the Resources Planning Act and National Forest Management Act.

The ecosystem approach with the manpower available to the Rocky Mountain Station could provide some information on many species and their interactions while the individual species approach would provide detail and specifics on a small number of animals. Dale Jones at the National Range, Wildlife and Fisheries Workshop in November 1978 made a plea for the ecosystem or holistic approach to our research.

A strong case can be made for research on individual animal and plant species particularly those classified as threatened and endangered. The NFMA requires NFS to use indicator species to monitor land management practices. The only way information can be developed for indicator

species is research on a single species to determine if they can be indicators of habitat change or modification. As detailed data accumulates on many single species the information can then be used to develop ecosystem models.

The second item in the Chief's policy letter is part of the current research program for several of the Station's work units. Work Unit RM 4151 is doing research on land classification systems and inventory techniques to meet the needs of RPA. The storage and retrieval system requested by the Chief by 1985 has already been developed for Region 3 by Research Work Unit 1710. Other regions are aware of the system and with slight modification can adopt it for their use. RM 1710 as part of the RUN WILD System is developing a hierarchical classification system for grouping wildlife species by their need for common environmental factors for reproducing and feeding. This hierarchical system is a different approach to ecosystem or holistic management. WESTFORNET has been introduced to managers and has been well received and used. However, it still needs more demonstration to field personnel before the system is effective over the entire Region 2 and 3 area. In addition to systems like RUN WILD and WESTFORNET, other means of accumulating and distributing research results are being used. One example is RM 1752's effort to produce a guide on aquatic habitat management for waterfowl on the northern Great Plains. Other projects have similar efforts to assist managers.

National Perspective

In Fiscal Year 1978 there were 38 research work units in 8 stations that received 513 funds for range, wildlife and fisheries research (Table 3). The largest number (9) of the RWU's is in the Rocky Mountain Station. These units account for 24 percent, nationwide, of the Forest Service's research program for range, wildlife and fish.

A comparison of the Station's 9 RWU's and their current research efforts with national priorities, as determined by the National Program of Research for Forests and Associated Rangelands, is shown in Tables 4 and 5. There is some overlap in the two tables because range and wildlife scientists perceive the same problems of livestock and wildlife interactions.

Even though the Station is listed as doing research on a particular problem there may be a need for additional work because the SMY's now may be low. Tables 4 and 5 reflect only the fact that some effort is being devoted to the problem. Regional and national priorities coincide in several instances. For example, Regional problem 1 (Table 2) is the same as National priority 8 (Table 4) and 6 (Table 5); National problem 4 (Table 5) is the same as Regional problem 3 (Table 2). There is enough commonality of priorities to say that the problems identified by Regions 1, 2 and 3 also reflect National concerns.

Table 3.--Summary of the range, wildlife and fisheries research program for FY 1978.

Station	Number of locations receiving 513 funds	Number of RWU's re- ceiving 513 funds	Number of functional (1700) RWU's receiving 513	Number of multifunc- tional (1700) RWU's	Number of multifunctional RWU's where 1700 does not have lead
SE	4	4	1	1	2
SO	3	3	1	1	1
NE	4	4	1	-	3
NC	2	2	2	-	-
RM	6	9	4	2	3
INT	5	6	2	3	1
PNW	4	6	2	-	4
PSW	3	4	2	1	1
Totals	31	38	15	8	15

Table 4.--Ten highest priority range research problems identified in the National Program of Research for Forests and Associated Rangelands, 1977-78.

No.	Problem description	Current research work unit efforts	No. of units
1	Develop a national system for identification, classification, and inventory of range ecosystems including site potential (past and present), condition, and realistic opportunity for improvement.	RM 4151	1
2	Determine impact of grazing on multiple-use objectives	RM 1751, 1952, 4151, 1251	4
3	Determine ecologic and economic results of various mechanical, chemical and biological range improvement practices on a site specific basis.	RM 1713, 4151	2
4	Improve usefulness of remote sensing as a tool for inventory purposes and in monitoring ecological response of areas to different management treatments.	RM 1752, 4151	2
5	Develop methods of revegetation of disturbed lands using improved native or introduced herbaceous and woody plant species and determine requirements for successful germination, emergence, and stand establishment.	RM 1651, 1752	2
6	Analyze effects of livestock grazing systems on wildlife.	RM 1710, 1712, 1752, 4151	4
7	Search for new and innovative sources of water to meet needs of fish, wildlife and domestic livestock.	RM 1752	1
8	Determine means of ameliorating effects of livestock on the riparian habitat.	RM 1710, 1713, 1752	3

Table 4 (Continued)

No.	Problem description	Current research work unit efforts	No. of units
9	Develop criteria for quantifying effects of competition between domestic livestock and fish and wildlife.	RM 1713, 1752, 4151	3
10	Determine effects of different types of grazing systems and intensities on watershed properties of forest-rangeland areas.	RM 1710, 1752, 4151	3

Table 5.--Ten highest priority wildlife and fish research problems identified in the National Program of Research for Forests and Associated Rangelands, 1977-78.

No.	Problem description	Current research work unit efforts	No. of units
1	Develop and evaluate prescribed burning techniques for improvement of wildlife and livestock habitats.	RM 1752	1
2	Determine effects of range improvement practices on fish and wildlife habitat.	RM 1713, 1752, 4151	3
3	Analyze impact of livestock grazing systems on wildlife community interrelationships.	RM 1712, 1713, 1752, 4151	4
4	Determine minimum habitat requirements needed to maintain populations of various wildlife species.	RM 1710, 1712, 1713, 1752	4
5	Establish a system for placing quantitative values on such forest land resources as wildlife, scenery and soil protection.	RM 1713, 1752, 4151	3
6	Develop strategies for protecting, rehabilitating and managing aquatic and associated riparian ecosystems to enhance fish and wildlife habitat under multiple use management systems.	RM 1713, 1752, 1710	3
7	Determine effects of silvicultural practices on fish and wildlife habitats.	RM 1710, 1712, 1751, 1752, 4151 1251	6
8	Assess effects of livestock grazing on water quality and fish production and develop criteria for coordinating grazing with fish management needs.	RM 1751, 4151	2

Table 5 (Continued)

No.	Problem description	Current research work unit efforts	No. of units
9	Develop methods to provide comprehensive-coordinated use of existing information for improved resource management decisions.	RM 1710, 1713, 1751, 1251, 4151, 1752	6
10	Determine impacts of wilderness designation and recreation activities on future abundance and diversity of wildlife.	RM 1712, 4151	2

Appendix A.--Range, Wildlife and Fisheries Workshop Program

Tuesday, December 5

0800	INTRODUCTIONS AND OPENING REMARKS	David R. Patton
0820	PURPOSE OF WORKSHOP	Dixie R. Smith
0900	NATIONAL DIRECTION Report on National Workshop	Project Leaders <u>1/</u>
0945	B R E A K	
	REGIONAL RESEARCH NEEDS	
	Region 2	Sidney Hanks Wallace B. Gallaher
	Region 3	Willard R. Fallis William D. Zeedyk
1200	L U N C H	
1300	CURRENT RANGE, WILDLIFE AND FISHERIES RESEARCH PROGRAM, Rocky Mountain Station	

	<u>RWU</u>
Aldon	1651
Bjugstad	1752
Carder	1654
Crouch	1251
DeBano	1606
Driscoll	4151
Morris	1751
Patton	1710
Stormer	1713
Ward	1712

Wednesday, December 6

0800	CURRENT RESEARCH PROGRAM (continued)	
1000	B R E A K	
1030	CURRENT RESEARCH PROGRAM (continued)	
1200	L U N C H	
1300	OPPORTUNITIES FOR NEW RESEARCH	Sam R. Krammes
1400	DEVELOP RECOMMENDATIONS AND LIST PRIORITIES	Workshop Committee <u>2/</u>
1400	INHIBITORS TO PRODUCTIVE RESEARCH	Scientists <u>3/</u>
1700	ATTITUDE ADJUSTMENT	

Thursday, December 7

0800	COMMITTEE OF SCIENTISTS REPORT	Frank Ronco
0830	REPORT ON RECOMMENDATION AND PRIORITIES	Workshop Committee
1000	B R E A K	
1030	REPORT ON RECOMMENDATION AND PRIORITIES (continued)	
1200	L U N C H	
1300	OPEN DISCUSSION OF PROBLEMS ENCOUNTERED IN RANGE, WILDLIFE AND FISHERIES RESEARCH (Group Reports)	Committee of Scientists Representative <u>4/</u>
1500	A D I O S A M I G O S	

1/ Assignments to be made

2/ Workshop Committee: Bjugstad, Crouch, Martin, Patton and Ward with Regional Representatives

3/ Discussion Leaders: Group 1 - Knipe Group 2 - Severson

4/ Patton, RM Representative for Range, Wildlife and Fisheries.

Appendix B.--Current staffing of range, wildlife and fisheries scientists.

<u>Scientist</u>	<u>Classification</u>	<u>RWU</u>
Glen Crouch	Research Wildlife Biologist	RM 1251
Duane Knipe	Research Range Scientist	RM 1606
Earl Aldon	Research Forester-Range	RM 1651
Charles Pase	Research Forester-Range	RM 1651
Terry Grubb	Research Wildlife Biologist	RM 1710
S. Clark Martin	Principal Range Scientist	RM 1710
David R. Patton	Supervisory Wildlife Biologist	RM 1710
John Rinne	Research Fisheries Biologist	RM 1710
Kieth Severson	Research Wildlife Biologist	RM 1710
Bob Szaro	Research Wildlife Biologist	RM 1710
Loren Ward	Research Wildlife Biologist	RM 1712
Fred Stormer	Research Wildlife Biologist	RM 1713
Meredith Morris	Research Wildlife Biologist	RM 1751
Ardell Bjugstad	Supervisory Range Scientist	RM 1752
Clifford Hawkes	Research Aquatic Biologist	RM 1752
Dan Uresk	Research Wildlife Biologist	RM 1752
Richard Driscoll	Supervisory Range Scientist	RM 4151
Dick Francis	Research Range Scientist	RM 4151
Tom Hoekstra	Research Wildlife Biologist	RM 4151

Appendix C.--Research Work Units that receive range, wildlife and fisheries funds (513)

<u>RWU</u>	<u>Short Title</u>	<u>Location</u>
1251	Subalpine Forests	Fort Collins, CO
1651	Mine Spoil Reclamation	Albuquerque, NM
1710	Habitat Criteria for Southwest Wildlife	Tempe, AZ
1712	Impacts on Big Game	Laramie, WY
1751	Montane and Foothills	Fort Collins, CO
1752	Environmental Improvement	Rapid City, SD
1713	Southern Great Plains	Lubbock, TX
4151	Resource Evaluation Techniques	Fort Collins, CO

Appendix D. Current range, wildlife and fisheries studies.

1. Use of non-mine wastes as soil amendments on coal spoils in semi-arid and arid environments. (RM-1651)
2. Species adaptability trials on mine spoils in New Mexico. (RM-1651)
3. Adaptability of selected tree and shrub species on coal mine spoils in Campbell County, Wyoming. (RM-1752)
4. Adaptability of selected tree and shrub species on bentonite mine spoils, Cook County, Wyoming and Butte County, South Dakota. (RM-1752)
5. Enhancement of shrub and tree establishment with drip irrigation and use of container grown stock on coal mine spoils in Campbell County, Wyoming. (RM-1752)
6. Cultural treatment for establishment of shrub and tree species on coal mine spoils, ARCO Black Thunder coal area, Campbell County Wyoming. (RM-1752)
7. Survival and growth of containerized versus bare root shrub and tree planting stock on bentonite spoils in northeastern Wyoming. (RM-1752)
8. Invertebrate species, abundance and standing crop biomass in strip mine ponds compared to stock ponds in the northern Great Plains. (RM-1752)
9. The synthesis of information to develop guidelines for managing strip mine water impoundments. (RM-1752)
10. Basin morphometry of strip mine ponds compared to stock ponds in the northern Great Plains. (RM-1752)
11. Water quality in strip mine ponds compared to stock ponds in northern Great Plains. (RM-1752)
12. Waterfowl use of water impoundment left by strip mining in the northern Great Plains. (RM-1752)
13. Ecological analysis of aquatic and terrestrial plant communities associated with selected strip mine and stock ponds in the northern Great Plains. (RM-1752)
14. Selection and increase of perennial forbs for mine spoils reclamation in the northern Great Plains. (RM-1752)
15. Nongame bird habitat associated with mine haul roads and surface mining for bentonite clay. (RM-1752)

16. The use of wood chips as a mulch in the reclamation of bentonite mine spoils. (RM-1752)
17. Selection and increase of woody plants for mine spoils in the northern Great Plains. (RM-1752)
18. Shrub and tree survival and growth in relation to jackrabbit, deer and antelope utilization. (RM-1752)
19. Influence of small mammal in the rehabilitation of areas disturbed during open pit mining. (RM-1752)
20. Renovation, establishment, and maintenance of woody vegetation in grassland draws of the northern Great Plains. (RM-1752)
21. Ecology of prairie deer in South Dakota. (RM-1752)
22. Prairie dog-cattle-vegetation interactions under a season-long spraying system in the northern Great Plains. (RM-1752)
23. Critical habitat and food habits of the swift fox. (RM-1752)
24. Critical habitat requirements of mule deer fawns. (RM-1752)
25. Use of natural woodland habitats by vertebrate wildlife. (RM-1752)
26. Rotation of understory vegetation to growing stock levels in Black Hills ponderosa pine. (RM-1752)
27. Analysis of understories of deciduous forest types in the Black Hills and Bear Lodge Mountains. (RM-1752)
28. Effect of shrub planting on production, nutritive content, and utilization of browse on a representative winter deer range in the Black Hills. (RM-1752)
29. Small patch clearing of a forested mountain watershed: An appraisal of multiple resource responses--water yield and quality, wildlife, forage and wood production. (RM-1752)
30. Establishing brush-grass mosaics in Arizona chaparral. (RM-1606)
31. Amphibians, birds, and reptiles in chaparral vegetation. (RM-1606)
32. Silvicultural practices for multi-resource management--a land-use pilot study. (RM-1251)
33. Growth and yield, soil moisture, changes in understory vegetation, and game animal response, in relation to overstory density in managed stands of young lodgepole pine on main St. Louis Creek, Frasier Experimental Forest. (RM-1251)

34. Small block clearcutting of aspen to improve wildlife habitat. (RM-1251)
35. Effects of commercial clearcutting on wildlife habitat and big game use in a pure stand of aspen in southwestern Colorado. (RM-1251)
36. National land classification for renewable resource assessments. (RM-4151)
37. Information needs assessment for multiresource inventories. (RM-4151)
38. Techniques for obtaining and utilizing soil survey information for local, regional, and national assessments. (RM-4151)
39. Techniques for vegetation inventory and analysis. (RM-4151)
40. Phytomass production of habitat types on the critical mule deer range in Middle Park, Colorado. (RM-4151)
41. Habitat type classification in Region 2, USFS. (RM-4151)
42. Rangeland phytomass estimation from LANDSAT. (RM-4151)
43. Wildlife and fish habitat parameters for National Assessment. (RM-4151)
44. Range and pasture output response and production function estimation. (RM-4151)
45. Techniques for National Assessment of wildlife and fish. (RM-4151)
46. Evaluation procedures for determining multiresource use interactions. (RM-4151)
47. Relationship between ponderosa pine and understory plant growth. (RM-1751)
48. Cattle gain comparisons under rotation and season-long grazing on ponderosa pine bunchgrass ranges. (RM-1751)
49. Effects of grazing on water quality as assessed by aquatic macroinvertebrates. (RM-1751)
50. Effects of various levels of water quality on stream biology. (RM-1751)
51. Effects of waste water effluent streams and fishery biology. (RM-1751)
52. A field guide to aquatic insects of mountain streams in Colorado--with special emphasis on water quality evaluation. (RM-1751)
53. Abert squirrel feeding preference in ponderosa pine. (RM-1751)
54. Niche relationships among pine foliage gleaning birds in different competitive regimes. (RM-1751)

55. Wintering and nest distribution of the bald eagle. (RM-1710)
56. Guidelines for managing habitat for mule deer and elk in the Southwest. (RM-1710)
57. Distribution and management of the riparian type. (RM-1710)
58. Habitat requirements of cottontails in ponderosa pine. (RM-1710)
59. Artificial establishment of riparian forests. (RM-1710)
60. The distribution and abundance of endangered fish in Arizona. (RM-1710)
61. Distribution and abundance of nongame birds in riparian vegetation. (RM-1710)
62. Effects of herbicides from range watersheds on fish growth. (RM-1710)
63. Effects of stream sedimentation from highway sand and salt on aquatic invertebrates. (RM-1710)
64. A model to predict density and diversity of birds in ponderosa pine forests. (RM-1710)
65. Habitat requirements, biology and distribution of native Arizona and Gila trout. (RM-1710)
66. Reducing the impacts of cattle grazing in riparian habitats in the southwestern national forests. (RM-1710)
67. Changes in herbaceous vegetation, erosion and runoff on mesquite free and mesquite infested small watersheds on the Santa Rita Experimental Range. (RM-1710)
68. Effects of fall burning on semidesert grasses and shrubs. (RM-1710)
69. Benefits of rest--March to October two years out of three. (RM-1710)
70. Distribution and habitat requirements of the southern bald eagle. (RM-1710)
71. Habitat requirements for blue grouse in southwestern coniferous forests. (RM-1710)
72. Distribution and movement of wildlife horses on the Caja del Rio, Santa Fe National Forest. (RM-1710)
73. Assessment of snag policies and their effect on timber harvests. (RM-1710)
74. Distribution of fishes in New Mexico. (RM-1710)

75. Man's past and present impact on the status and distribution of the Texas pronghorn. (RM-1713)
76. The past and present status and distribution of the mule deer in Texas. (RM-1713)
77. Survey of the range and adaptability of the ring-necked pheasant on the Southern High Plains. (RM-1713)
78. Development of a bibliography of fauna and flora of playa lakes on the Llano Esticado. (RM-1713)
79. Status of knowledge of lesser prairie chickens. (RM-1713)
80. Response of several wildlife species to two types of brush control in south Texas. (RM-1713)
81. Survey of playa lakes on the Southern High Plains and their importance to migratory waterfowl. (RM-1713)
82. Survival and ecology of mule deer fawns in Pecos County, Texas. (RM-1713)
83. Habitat use and productivity of mule deer in the Texas Panhandle. (RM-1713)
84. Ecology and management of ring-necked pheasants in the Texas Panhandle. (RM-1713)
85. Dispersal and establishment of Aoudad sheep. (RM-1713)
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87. Economics of playa lakes under hunting use. (RM-1713)
88. Economic and financial analysis of rough land-improved land mixes for wildlife habitat and agricultural commodity production. (RM-1713)
89. Habitat requirements of scaled quail in the rolling plains. (RM-1713)
90. The effects of highway operation practices and facilities on elk, mule deer and pronghorn antelope. (RM-1712)
91. Determine big game behavior and movements following timber harvest and activities related to increased human ingress. (RM-1712)
92. Develop baseline ecological guidelines for evaluating the adequacy of restoration measures on surface-mined areas. (RM-1712)

93. Determine levels of lead from vehicle exhaust in vegetation and mule deer along Interstate 80. (RM-1712)
94. Elk distribution and movements in relation to multiple uses in the North Absaroka Mountain Range. (RM-1712)
95. Collation and development of habitat data in a storage and retrieval system for southwestern wildlife species. (RM-1710)

Appendix E. Problem areas identified by Region 2 and 3.

1. Develop basic information for managing riparian vegetation.
 - A. Determine soil, water, plant and animal relationships that exist and influence vegetation establishment and survival.
 - B. Develop a taxonomic classification system for riparian vegetation.
 - C. Determine the effects of grazing and grazing systems on riparian vegetation.
 - D. Develop techniques for evaluating condition and trend.
 - E. Determine carrying capacity for different uses.
 - F. Develop guidelines for management including trade-offs.
 - G. Develop inventory and mapping standards.
2. Develop basic information for management of aquatic habitats.
 - A. Develop a classification system for aquatic systems.
 - B. Determine the effects of land uses on water quality and quantity.
3. Determine habitat requirements, life history and population dynamics of wildlife species (includes fish) to include big game, small game, nongame and those classified as threatened and endangered.
4. Determine habitat requirements of threatened and endangered plants.
5. Develop information to meet the needs of the National Forest Management Act.
 - A. Develop criteria for indicator species.
 - B. Develop monitoring techniques for species population changes.
 - C. Develop habitat models to predict trade-offs for individual species or groups of species by vegetation type.
 - D. Develop data storage and retrieval system.
6. Develop techniques to improve habitat of selected species or groups of species by using fire, direct seeding and planting, livestock, silviculture systems and plant control methods.

7. Develop coordination techniques for range and wildlife habitat management.
 - A. Develop scorecards for different vegetation types to determine condition and trend.
 - B. Determine economic and physical trade-offs between livestock and other rangeland uses.
8. Determine carrying capacity of different vegetation types for livestock, wildlife and recreation use.
9. Determine the importance of specific types of hardwood species for livestock and wildlife to include woody draws and oak brush.
10. Determine the importance of brush piles, stumps, rotten logs, and snags to different wildlife species.

Appendix F. Range, wildlife and fisheries manuscripts for the period 1976-1978.

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